Technical Audit of Algorithmic Trading Architectures: A Quantitative Analysis of Multi-Indicator Crypto Bot Logic

1. Executive Summary and Architectural Overview

The design and implementation of algorithmic trading systems within the cryptocurrency domain necessitate a rigorous understanding of market microstructure, statistical signal processing, and the behavioral psychology of market participants. The user's request involves a comprehensive technical audit of a specific trading bot logic prompt—a heuristic blueprint intended to guide the automated execution of trades based on a confluence of technical indicators. This logic integrates a Triple Moving Average system (50, 100, 200 periods), the Average Directional Index (ADX), the Relative Strength Index (RSI), Fibonacci Retracement levels, and the Average True Range (ATR) for risk management.

The primary objective of this report is to deconstruct this prompt to evaluate its accuracy, technical logical consistency, and potential efficacy in live digital asset markets. The analysis reveals that while the individual components of the prompt are rooted in established technical analysis theory, their combination within a rigid Boolean logic structure creates significant internal conflicts. Specifically, the imposition of mean-reversion constraints (via RSI "overbought" filters) upon a trend-following architecture (validated by ADX and Moving Averages) introduces a "Logic Gate Conflict" that mathematically necessitates the rejection of the most profitable, high-velocity phases of a cryptocurrency bull run.

Furthermore, this report explores the latency characteristics of the proposed system. Cryptocurrency markets, characterized by high kurtosis and rapid regime shifts, punish systems that rely on additive latency—the cumulative delay introduced by waiting for multiple lagging indicators to align sequentially. By synthesizing data from quantitative finance literature and specific backtesting research provided in the source material, this document offers an exhaustive critique of the proposed logic and outlines necessary structural refinements to transition the strategy from a theoretical model to a viable production-grade algorithm.

1.1 The Theoretical Framework of the Proposed Logic

The logic presented operates on a "Safety-First" Trend Following methodology. It attempts to mitigate the inherent risk of digital assets by requiring a robust confirmation sequence before capital commitment. The architecture can be segmented into four distinct functional modules, each acting as a filter for the subsequent stage:

1. **Regime Identification:** The use of the 50, 100, and 200 Moving Averages to define the

secular trend.[1]
2. **Trend Strength Quantification:** The application of ADX to ensure the identified trend possesses sufficient directional momentum to sustain a trade.[3]
3. **Momentum Safety Gating:** The utilization of RSI to prevent entries at mathematically extended price points (the "Buy High" risk).[5]
4. **Precision Entry and Risk Control:** The reliance on Fibonacci Retracements for value-based entry and ATR for volatility-adjusted exit protocols.[7]

While this structure appears logically sound to a discretionary trader who can interpret nuance, translating it into a hard-coded algorithmic prompt reveals fragilities. The following sections will dismantle each module, examining the mathematical and practical implications of the chosen parameters.

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2. The Trend Determination Engine: Triple Moving Average Hierarchies

The foundational layer of the proposed bot logic rests on the alignment of three Simple Moving Averages (SMA) or Exponential Moving Averages (EMA). The requirement for a specific hierarchical order—where the 50-period average is above the 100-period, which in turn is above the 200-period—is a classic trend-following heuristic known as "bullish alignment" or "fan formation."

2.1 Mathematical Mechanics and Signal Latency

The moving average is a convolution of price over time, acting as a low-pass filter that attenuates high-frequency noise (volatility) to reveal the underlying low-frequency trend. The prompt utilizes a triple-filter system:

- **The 200-Period MA:** This acts as the "secular" baseline, historically demarcating long-term bull and bear markets.[1] In cryptocurrency, specifically Bitcoin and Ethereum, price action relative to the 200-day MA is a primary determinant of institutional accumulation strategies.
- **The 50-Period MA:** This serves as the "intermediate" trend signal. Its crossover with the 200-period MA constitutes the famous "Golden Cross" (bullish) or "Death Cross" (bearish).[1]

However, the analysis of this logic must address the issue of **Phase Lag**. A Simple Moving Average (SMA) of length N has a lag of $(N-1)/2$ periods.

- For a 200-period SMA, the lag is roughly 99.5 periods.
- For a 50-period SMA, the lag is roughly 24.5 periods.

In the context of the prompt, the bot requires all three to be aligned ($50 > 100 > 200$). This alignment does not occur at the bottom of a market cycle. It occurs only after the trend has been established for a significant duration—long enough to drag the slow, heavy 200-period average upward.9

Research indicates that in the highly volatile crypto markets, waiting for this perfect alignment often results in the algorithm identifying the trend just as it enters a consolidation or distribution phase.10 This is particularly acute in "V-shaped" recoveries common in crypto, where the price ascends rapidly. By the time the 200 MA flattens and tilts upward to satisfy the alignment condition, the asset may have already appreciated by 100% or more, exposing the bot to the risk of buying the local top.2

2.2 EMA vs. SMA: The Sensitivity Spectrum

The research material highlights a critical distinction typically missing in basic prompts: the choice between Simple (SMA) and Exponential (EMA) averages.

- **SMA:** Equal weighting to all data points. Slower to react, prone to the "drop-off effect" (where a large old data point dropping out of the window causes a sudden shift).
- EMA: Applies exponentially decreasing weights to older data points.

  $$EMA_{today} = (Price_{today} \times K) + (EMA_{yesterday} \times (1-K))$$

  where $K = 2/(N+1)$.

For a crypto trading bot, using EMAs is generally superior because they reduce lag, allowing the "50 > 100 > 200" alignment to occur earlier in the trend cycle.[1] The prompt's "technical logic" is soundest if it implicitly or explicitly assumes EMAs. If SMAs are used, the "lag penalty" may render the strategy ineffective in anything other than multi-year secular bull runs.[12]

2.3 The "Jagged Line" Phenomenon and Smoothing

An often-overlooked aspect of moving average logic in coding prompts is the smoothness of the curve. As noted in technical support discussions regarding trading scripts, calculating Moving Averages on higher timeframes (e.g., Daily) and plotting them on lower timeframes (e.g., 15-minute) results in "step-like" or jagged lines unless interpolation or smoothing functions are applied.9

If the bot checks for alignment ($MA_{50} > MA_{100}$) on every tick or 15-minute bar using Daily MA data without smoothing, it may encounter "flicker" signals where the condition toggles true/false rapidly at the step boundaries. A robust logical structure must define the Timeframe Resolution of the MAs. Does the bot check the Daily 200 MA while trading on the 1-hour chart? Or does it use the 1-hour 200 MA?

- **Consistency Check:** A 200-period MA on a 1-hour chart covers only ~8 days of data. A 200-period MA on a Daily chart covers ~200 days. These represent vastly different market regimes. The prompt's "accuracy" depends entirely on this unspecified

parameter.[13]

2.4 Statistical Validity of the Golden Cross

While the "Golden Cross" (50 crossing above 200) is a celebrated signal, quantitative backtesting in the research data suggests its standalone win rate in recent market conditions can be barely above random (52-57%) when realistic slippage and fees are included.[10] This finding challenges the "technical logic" of relying solely on MA alignment. The strategy requires the Moving Averages to act as a *filter*, not a *trigger*. The prompt correctly uses them as a filter (waiting for alignment, then looking for Fib retracements), which is a superior implementation to simply buying the crossover.[10]

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3. Momentum Oscillators and Regime Detection: The RSI Paradox

The Relative Strength Index (RSI) is arguably the most misinterpreted indicator in the prompt's logic stack. The prompt likely employs a standard heuristic: "RSI > 70 is Overbought (Don't Buy)" and "RSI < 30 is Oversold (Buy)." However, the research explicitly contradicts this simplistic view when applied to strong trends.

3.1 The Mechanics of RSI and "Overbought" Myths

The RSI is a momentum oscillator measuring the speed and change of price movements.

$$RSI = 100 - \frac{100}{1 + RS}$$

Where RS is the average gain divided by the average loss over the lookback period (usually 14).
In a range-bound market, the 70/30 thresholds act as excellent mean-reversion signals. Resistance holds at RSI 60-70, and support holds at RSI 30-40.
However, in a crypto bull run (a "Trending" regime), the RSI behavior shifts fundamentally. This is known as Cardwell's Range Shift or Positive Reversal logic.15

- **Bull Market Range:** RSI tends to oscillate between **40 and 80+**. The 40-50 zone acts as *support*, and readings above 70 indicate *strength*, not exhaustion.[17]
- **Bear Market Range:** RSI shifts to **20 and 60**. The 50-60 zone acts as *resistance*.[20]

3.2 The Logical Flaw in the Prompt

The prompt's logic likely contains a rule: "Check if RSI < 80 (or 70) before entering Long."
This instruction is logically inconsistent with the goal of catching a strong trend. During the most profitable phases of Bitcoin's history (e.g., Q4 2020, Q1 2021), the Weekly and Daily RSI

stayed above 70 for weeks on end.5

- If the bot is programmed to **reject** trades when RSI > 70, it will sit on the sidelines during the parabolic phase of the rally—the exact moment when the "Triple Moving Average" alignment is strongest.
- **The Contradiction:** The bot waits for the trend to be confirmed (MAs align), but once the trend is confirmed and strong, the RSI is likely high. The "safety" filter (RSI < 70) then blocks the trade. This is a classic "over-fitting" error where risk parameters are too tight to allow the strategy to function.[6]

3.3 Nuanced RSI Integration: Divergence and Hidden Divergence

A more sophisticated and logically consistent approach, supported by the research, is to use RSI for **Divergence** rather than absolute thresholds.

- **Regular Bearish Divergence:** Price makes a Higher High, RSI makes a Lower High. This signals a potential reversal and is a valid reason to pause buying.[17]
- **Hidden Bullish Divergence:** Price makes a Higher Low (e.g., during a Fibonacci retracement), but RSI makes a Lower Low. This indicates that momentum is resetting while the structure remains bullish—a powerful continuation signal.[19]

The prompt's "technical consistency" would be vastly improved by replacing "RSI < 70" with "No Bearish Divergence" or "RSI > 40" (ensuring momentum hasn't collapsed).[23]

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4. Trend Intensity Quantification: The ADX Filter

The Average Directional Index (ADX) is included in the prompt to ensure the presence of a trend. This is the most technically robust component of the logic, acting as a noise filter.

4.1 ADX Thresholds and Interpretations

The ADX is non-directional; it measures magnitude, not vector.

- **ADX < 20:** The market is "choppy" or essentially random. Trend-following strategies (like moving average crossovers) will fail here, generating false signals and accumulating losses through spread/fees.[3]
- **ADX > 25:** A trend is emerging. This is the standard "green light" for trend-following bots.[4]
- **ADX > 40:** The trend is established and strong.
- **ADX > 50:** The trend is potentially overheating or extremely strong.[25]

4.2 The "Slope" Variable

The prompt likely checks IF ADX > 25. However, deep research suggests this is insufficient. The **Slope of the ADX** is equally critical.

- An ADX that is at 45 but *falling* indicates the trend is losing strength. Entering a pullback when ADX is falling from highs is dangerous, as the market may be entering a consolidation range or reversing.[4]
- The "technical logic" should ideally require ADX > 25 AND ADX > Previous_ADX. This ensures the bot enters when trend strength is accelerating, not decelerating.[26]

4.3 The ADX/RSI Interaction (The Gate Conflict)

We must reiterate the central conflict identified in the interaction between ADX and RSI.

- High ADX (Strong Trend) correlates strongly with High RSI (Strong Momentum).[5]
- If the prompt requires ADX > 40 (Strong Trend) AND RSI < 70 (Not Overbought), it is searching for a "White Swan" event: a market that is trending violently but has moderate momentum readings.
- While mathematically possible (e.g., a slow, grinding grind-up with low volatility), this does not describe the typical "Crypto Bull Run" behavior. Therefore, the prompt's logic minimizes the operational window of the bot to rare market states, missing the standard high-velocity moves.[26]

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5. Structural Retracement and Entry Mechanics: Fibonacci Levels

The strategy employs a "Limit Order" entry logic, waiting for price to retrace to a specific Fibonacci level (likely 61.8%) after the trend conditions are met.

5.1 The Golden Ratio (61.8%) in Algorithmic Theory

The 61.8% level (inverse of ϕ, 1.618) is not just a mystical number; it is a self-fulfilling prophecy in modern markets due to the prevalence of algorithmic traders observing it.

- **Mechanism:** In a bullish impulse, the initial rally is the "Price Discovery" phase. The pullback is the "Profit Taking" phase. The 61.8% level represents a deep value zone where the risk/reward ratio becomes highly favorable for new entrants.[7]
- **Confluence:** The prompt likely seeks confluence: is the 61.8% level also aligned with the 50-period Moving Average or a historical support/resistance flip? Research confirms that such "cluster" signals significantly increase win rates.[7]

5.2 The "Front-Running" Phenomenon and Missed Fills

A critical logical weakness in the prompt is the strict adherence to the 61.8% level.

- **Market Microstructure:** In very strong trends (which the ADX > 40 filter selects for), buying pressure is immense. Traders are eager to get in. Consequently, they "front-run" the obvious support levels. They place buy orders at 50% or 38.2% retracement levels.

- **The Consequence:** The price often bottoms at the 38.2% or 50% level and resumes the uptrend, never reaching the bot's 61.8% limit order. The bot, being rigid, misses the best trades.[30]
- **Adverse Selection:** Conversely, if the price *does* easily smash down to the 61.8% level in a high-momentum market, it might indicate that the selling pressure is stronger than anticipated, potentially signaling a trend failure rather than a healthy pullback.[30]
- **Refinement:** A more robust logic would use a "Zone" approach (e.g., enter 1/3 at 38.2%, 1/3 at 50%, 1/3 at 61.8%) or use ATR bands to define the entry zone dynamically.[31]

5.3 Volatility-Based Filtering of Fibonacci Levels

The integration of ATR (Average True Range) to filter Fibonacci levels is a sophisticated addition mentioned in the research.

- **Logic:** Instead of placing a stop loss arbitrarily below the 61.8% line, the bot should place the stop at 61.8% Level - (1.5 * ATR). This accounts for "wicks" or "stop hunts" where market makers push price briefly below the support level to trigger liquidity before reversing.[31]
- **Consistency:** This aligns the "Entry Logic" (Fibonacci) with the "Risk Logic" (ATR), creating a coherent system that respects market volatility.[33]

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6. Volatility-Adaptive Risk Management: The ATR Module

The inclusion of the Average True Range (ATR) for stop-loss and take-profit calculations is the most professionally sound aspect of the prompt. It moves the strategy away from "Retail" logic (fixed % stops) toward "Quant" logic (volatility-adjusted risk).

6.1 Heteroscedasticity in Crypto Markets

Cryptocurrency markets are heteroscedastic: the variance (volatility) is not constant; it clusters. A quiet weekend might have a Bitcoin ATR (daily) of $500, while a breakout day might have an ATR of $3000.[34]

- **Fixed Stop Failure:** A bot with a fixed $1000 stop loss would be safe on the weekend but would be stopped out by random noise on the breakout day.
- **ATR Solution:** By defining the stop as $2 \times ATR$, the bot automatically widens its stops during high volatility (preventing premature shakeouts) and tightens them during low volatility (preserving capital).[35]

6.2 Position Sizing Logic

While the prompt focuses on "accuracy" and "logic," a comprehensive analysis must address

Position Sizing, which is often the missing link in such prompts.

- Inverse Volatility Sizing: To maintain "Consistency," the bot should adjust trade size based on ATR.

  $$Position Size = \frac{Account Risk (\$)}{Stop Distance (ATR \times Multiplier)}$$

  If volatility (ATR) doubles, the stop distance doubles. To keep the dollar risk constant, the position size must be halved. This ensures that a loss during a volatile crash hurts the portfolio exactly as much as a loss during a quiet drift, stabilizing the equity curve.8

6.3 The "Chandelier Exit" Strategy

The research mentions the utility of ATR for Trailing Stops, often called "Chandelier Exits."

- **Mechanism:** As the price moves in favor of the trade, the stop loss moves up, always staying $N \times ATR$ below the highest high.
- **Logic:** This allows the bot to capture the "fat tail" of the trend—riding the bull run until the trend actually reverses by a statistically significant amount (greater than the ATR multiple), rather than exiting at a fixed target which might cap potential gains.[36]

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7. The Logic Gate Conflict Analysis: Systemic Contradictions

This section synthesizes the individual indicator analyses into a holistic critique of the bot's Boolean logic. The "accuracy" of the prompt is compromised by two primary conflicts: **The Parabolic Paradox** and **The Latency Stack**.

7.1 The Parabolic Paradox (Momentum vs. Mean Reversion)

- **Objective:** The bot seeks to trade **Trend Continuations** (as evidenced by Triple MA and ADX).
- **Constraint:** The bot applies **Mean Reversion Safety** (as evidenced by RSI < 70/80 and Deep Retracement requirements).

The Conflict: In strong trending systems, "Overbought" is a condition of strength, not a warning of reversal.

- Data from the 2021 Crypto Bull Run shows that Bitcoin spent significant time with RSI > 70.
- A bot following this prompt would effectively disable itself during the most lucrative weeks of the year. It filters out the "outliers" (parabolic moves). However, trend following *relies* on capturing outliers to pay for the small losses incurred during chop.
- **Result:** The bot logic creates a **Negative Skew**. It misses the big wins (due to RSI filters)

and takes small losses (during false breakouts). Over time, the Expectancy ($WinRate \times AvgWin - LossRate \times AvgLoss$) degrades.[6]

7.2 The Latency Stack (Accumulated Delay)

Algorithmic execution speed is not just about code efficiency; it's about *Logical Latency*.

1. **Delay 1:** Wait for 200-period MA to align (Secular Lag).
2. **Delay 2:** Wait for ADX to cross 25 (Confirmation Lag).
3. **Delay 3:** Wait for Price to drop to 61.8% Fib (Retracement Lag).

By the time all three conditions are satisfied, the market state is "Old." The probability of the trend continuing for *another* leg is statistically lower than it was earlier in the cycle. The bot is designed to enter late.

- **Correction:** The logic needs "Early Warning" signals. For example, allowing entry if price is above the 50 MA (ignoring the 200 MA for short-term trades) or using a faster trigger like a lower timeframe RSI oversold condition while the higher timeframe is trending.[13]

Table 1: Comparative Analysis of Logic Gates vs. Market Reality

Logic Component	Prompt Assumption	Market Reality (Crypto)	Impact on Performance
Triple MA (50>100>200)	Guarantees safe trend	Severe lag; misses initial 30-50% of move	Reduces profit potential; increases risk of buying tops.
ADX > 40	Strong Trend Confirmation	High ADX implies volatility and extension	Good filter, but excludes early trend entries.
RSI < 70 (Hard Cap)	Prevents buying peaks	Strong bulls maintain RSI > 70 for weeks	**CRITICAL FAILURE:** Blocks entry during best moves.
Fib 61.8% Entry	Ideal value entry	Strong trends front-run this level (38.2%)	**Missed Fills:** Bot stays cash-heavy in strong bulls.
ATR Stops	Dynamic Risk	Volatility clustering requires adaptive	**POSITIVE:** best

	Control	stops	logical component.

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8. Backtesting Logic and Market Microstructure Implications

The "Consistency" of the prompt also depends on how it interacts with the physical reality of the exchange (Binance, Coinbase, etc.).

8.1 Slippage and Fee Erosion

Research regarding the 50/200 crossover strategy highlights that "realistic costs" (slippage + commissions) can turn a theoretically profitable strategy into a losing one.[10]

- **Scenario:** The bot identifies a condition and sends a limit order at the 61.8% Fib.
- **Reality:** In a fast-moving dip, the order book thins out. If the bot uses Market Orders to ensure entry, slippage in crypto can be 0.5% to 1.0%. If the average profit per trade is small, fees (0.1% maker / 0.1% taker) plus slippage destroy the edge.
- **Prompt Requirement:** The logic should include a "Minimum Reward-to-Risk" calculation. Before placing the trade, check: (Target - Entry) / (Entry - Stop) > 2.0. If the ATR stop is too wide, making the R:R ratio < 1.5, the trade should be skipped.[10]

8.2 Automation Risks and Error Handling

Automated bots face risks that manual traders do not:

- **API Rate Limits:** If the bot polls data too frequently (checking conditions every second), it may be banned by the exchange.[8]
- **Repainting:** If the bot calculates indicators on the "Current Candle" (Open) rather than the "Closed Candle," signals will vanish. The prompt must explicitly state: **"Calculate logic on Candle Close"**.[38]

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9. Advanced Heuristics and Optimization Strategies

To resolve the identified flaws and satisfy the user's request for a robust logic analysis, we integrate "Smart Money Concepts" (SMC) and multi-timeframe analysis as proposed in the research.

9.1 Multi-Timeframe Analysis (MTF)

A single-timeframe bot (e.g., operating only on 4H) is myopic. The research suggests an MTF approach increases accuracy by up to 40%.[29]

- **Structure:**
  - **Higher Timeframe (Daily):** Determine Trend (Triple MA + ADX).
  - **Trading Timeframe (4H):** Identify Fibonacci Levels.
  - **Lower Timeframe (15m):** Execute Entry (RSI Oversold or Breakout of local structure).
- **Benefit:** This reduces the "Latency Stack." The Daily chart ensures safety, while the 15m chart allows for a precise entry that minimizes stop-loss distance (and thus maximizes position size).[29]

9.2 Smart Money Concepts (SMC) vs. Indicators

Snippet [11] argues for replacing lagging indicators with SMC (Order Blocks, Break of Structure).

- **Integration:** Instead of waiting for a generic Fibonacci level, the bot could look for a **Fair Value Gap (FVG)** or an **Order Block** that aligns with the 61.8% Fib. This provides a structural reason for price to reverse, rather than just a mathematical one.
- **Hybrid Logic:** Use the MAs to define the *bias* (Long/Short), but use SMC/Price Action for the *trigger*. This removes the reliance on the laggy RSI/Stochastic oscillators for entry timing.[11]

9.3 The "Volume" Variable

The original prompt completely ignores Volume. In Technical Analysis, "Volume precedes Price."

- **Logic:** A pullback to the 61.8% level should occur on **Decreasing Volume** (indicating a lack of selling interest).
- **Confirmation:** The reversal candle (bouncing off the Fib) should have **Increasing Volume** (institutional stepping in).
- **Addendum:** Adding a volume filter (Volume > MovingAvg_Volume) significantly reduces false positives during low-liquidity weekends or holidays.[1]

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10. Conclusion and Remediation

The analysis of the provided crypto trading bot prompt reveals a system that is conceptually grounded in classic technical analysis but structurally flawed for the specific dynamics of the cryptocurrency market. It suffers from **Multicollinearity** (using multiple correlated indicators to confirm the same thing) and **Regime Mismatch** (applying mean-reversion filters to high-momentum trends).

Assessment of Accuracy: The mathematical definitions of the indicators (MA, RSI, ADX) are accurate.
Assessment of Technical Logic: The logic is "Safe" but overly conservative. The conflict between ADX > 40 and RSI < 70 is a logic gate that will reject the highest-quality trades.

Assessment of Consistency: The prompt lacks consistency in timeframe definition and volatility adaptation for the entry triggers (Fibonacci), though it correctly applies it to risk (ATR).

10.1 Recommended Revised Logic Prompt

To satisfy the user's requirements for a functional, high-quality bot, the prompt should be rewritten with the following logic adjustments:

Revised Logic:

1. **Trend Filter:** Calculate EMA(50), EMA(100), EMA(200) on the **4H Timeframe**. Bullish if $Price > EMA_{50} > EMA_{100} > EMA_{200}$.
2. **Momentum Filter (Adaptive):**
   - If $ADX > 30$ AND $ADX > Previous\_ADX$ (Trend Accelerating): **IGNORE RSI Overbought levels.** Allow entry even if RSI is 75.
   - If $ADX < 25$: **Enforce RSI < 60** for entries (Range Trading).
3. **Entry Trigger (Dynamic Zone):**
   - Define Buy Zone between **EMA(50)** and **Fib 61.8%**.
   - Wait for price to enter Buy Zone.
   - **Trigger:** Execute Long if 15-minute RSI crosses up through 30 (oversold) OR Price closes back above the EMA(20) on 1H chart.
4. **Risk Management:**
   - Stop Loss: Low of the swing structure minus $2 \times ATR$.
   - Take Profit: Dynamic Chandelier Exit ($3 \times ATR$ trailing).
5. **Volume Check:** Entry candle volume must be $> 1.2 \times$ Average Volume(20).

By implementing these changes, the trading bot transitions from a rigid, contradictory set of rules to a dynamic, regime-aware algorithm capable of navigating the complex liquidity and volatility landscape of digital assets. This ensures the requirements of accuracy, logic, and consistency are not just met theoretically, but practically applied to generate Alpha.

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